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Back to the basics: Integrating weed biology into weed management plans

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Herbicide-resistant giant ragweed and waterhemp continue to spread across the midwestern U.S. and are occurring more frequently in the same fields, making control with herbicides especially difficult. Weed biology is one of the most important factors to consider when developing a successful weed management program, with three main factors influencing success: 1) weed emergence patterns, 2) the weed seed bank, and 3) incorporating sound agronomic practices.

Each weed species has unique characteristics that influence weed emergence patterns, weed seed bank degradation, growth rates, and efficacy of various herbicides. Knowing these characteristics when developing a weed management plan can improve weed control considerably and save time and money. Giant ragweed and waterhemp have drastically different emergence patterns, which adds difficulty in obtaining excellent weed control in a field with both weeds, especially with herbicides alone. This presentation will discuss specifics of how weed management plans can be improved by incorporating knowledge of weed biology to manage herbicide-resistant weeds, with a primary focus on improving control of giant ragweed and waterhemp.

Weed emergence patterns

Weed emergence is driven by a number of factors that vary by weed species, and include temperature, light, nitrogen, and/or chilling period.

Giant ragweed

Giant ragweed is one of the earliest emerging weeds, with an emergence period of only several weeks (Figure 1). Soybean planting date can have a significant impact on giant ragweed density when soybean are planted following preplant tillage (Figure 1). Trials conducted in southeastern Minnesota have shown that delaying soybean planting until mid-May or later can remove over half of the total giant ragweed that emerge during the season. Soybean yield potential is still over 94% of optimal with a mid-May planting date, according to long-term research conducted in Minnesota (Hicks and Naeve). A later planting date has the added benefit of a much smaller giant ragweed population to control postemergence (Figure 1). In contrast, soybean yield potential of an early-May planting date will be close to optimal assuming weeds are controlled; however, pre-plant tillage removes less than 8% of the total giant ragweed with preplant tillage prior to an early planting date.

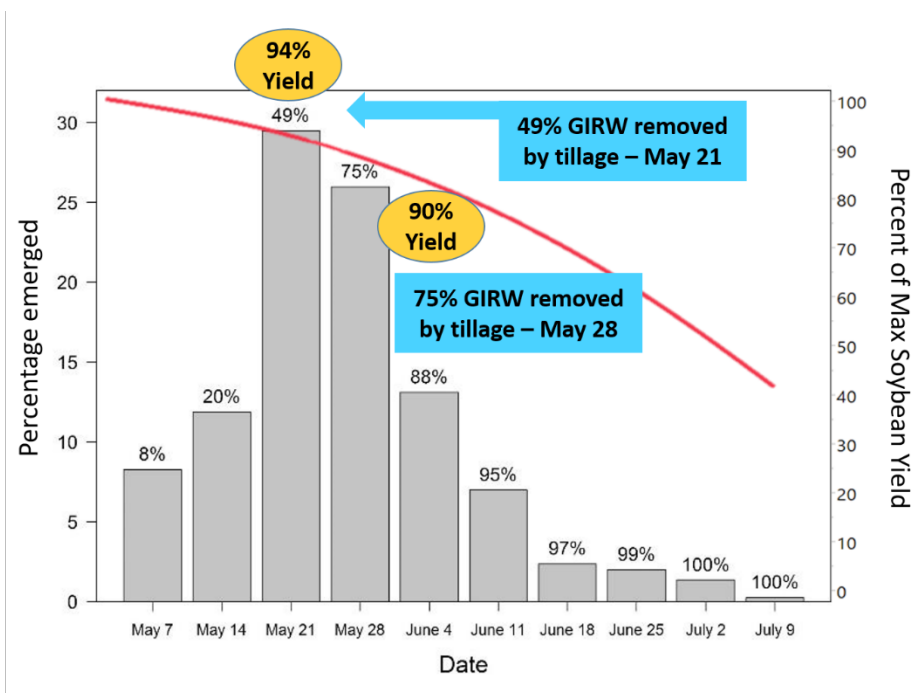


Figure 1. Giant ragweed emergence pattern and potential soybean yield during spring and early summer. Soybean yield potential is based on long-term U of MN research data (Hicks and Naeve). Giant ragweed emergence data from Goplen et al. (2017a, b).

Pre-plant tillage can be an effective weed control tool, especially when planting is delayed. Flushes of early-emerging weeds, such as giant ragweed, common lambsquarters, and winter annuals, can be taken out with pre-plant tillage as long as tillage is aggressive enough to destroy the weeds, and not just uproot and transplant them.

Waterhemp

Waterhemp has an emergence pattern that contrasts with the emergence pattern of giant ragweed. Waterhemp emerges later in the season, typically emerging over an eight to ten week time period. This is why residual herbicides, or the layering of residual herbicides (e.g. an application at planting and then 30 days later) is recommended for control of waterhemp (Figure 2). Delaying the planting date and preplant tillage may not be an effective strategy to control waterhemp with preplant tillage as it is for giant ragweed, but if both weeds are found in the same field the delayed tillage and planting can remove the majority of giant ragweed, allowing postemergence weed control to more-so target waterhemp. A delayed planting date may also allow the residual herbicide applications to be made late enough that control is extended through the entire waterhemp emergence period.

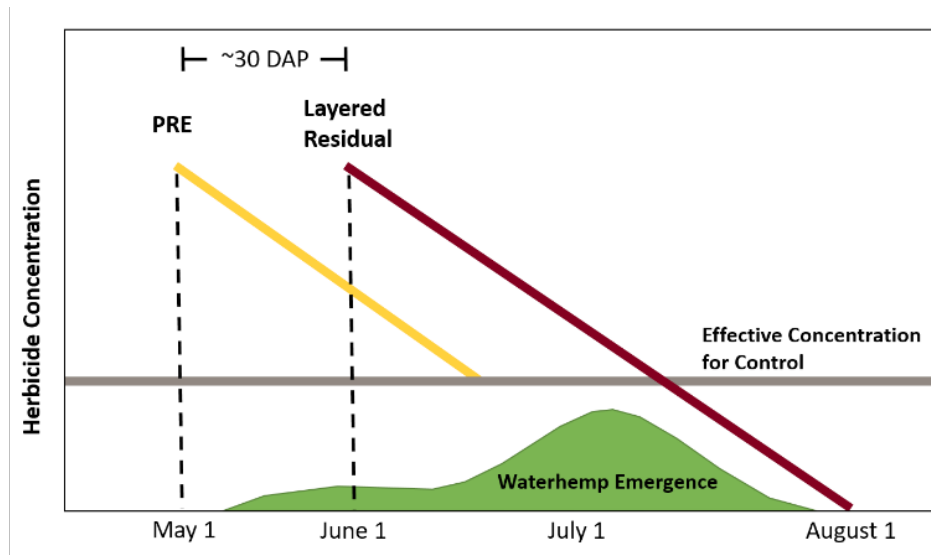


Figure 2. Concept of layering soil residual herbicides (PRE/POST) to provide season-long control of waterhemp populations in soybean. The green distribution represents the waterhemp emergence pattern.

Table 1. Waterhemp control and soybean yield with residual herbicides applied either PRE only or layered PRE/POST at Rochester, MN in 2016. The layered application was made approximately 30 days after planting. The waterhemp population was ALS inhibitor resistant. Means followed by different letters indicate a significant difference at $P \leq 0.10$ and $P \leq 0.20$ for waterhemp control and yield, respectively.

Herbicide ¹	Rate (Units ac ⁻¹)	Application timing	Waterhemp Control (%) ³	Yield ² (Bu ac ⁻¹)
Dual II Magnum	1.5 pt	PRE	76 b	45.7 bc
Dual II Magnum layered	1.5 / 1.0 pt	PRE/POST	94 a	47.7 abc
Outlook	18 fl oz	PRE	79 b	50.3 ab
Outlook layered	14 fl oz / 10 fl oz	PRE/POST	95 a	51.8 ab
Warrant	1.6 qt	PRE	79 b	42.2 c
Warrant layered	1.6 qt / 1.6 qt	PRE/POST	91 a	52.9 a

¹FirstRate (cloransulam) (Group-2) was applied PRE to control other broadleaf weeds in all treatments.

²Soybeans harvested October 14, 2016. Yield is adjusted to 13% moisture.

³Rating date was September 26, 2016.

Managing the weed seed bank

Seed production of weeds can vary significantly by species. Giant ragweed, for example has been found to produce from 1,800 to 10,000 seeds/plant, while waterhemp can average over 350,000 seeds/plant. Although competition with other plants can reduce seed production per plant, dense weed populations have the potential to produce tremendous amounts of weed seed. Considering that weed seeds can remain viable in the soil for years, one year of poor control can lead to significant weed control challenges for years to come.

Common lambsquarter is a long-term survivor in the weed seedbank, taking 78 years to deplete 99% of the seedbank (Sprague 2013). In contrast, research conducted in southeastern Minnesota demonstrated that the giant ragweed seedbank could be 97 percent depleted in two years (Goplen et al. 2017a). The waterhemp seedbank can be depleted by more than 99 percent in 4 years (Steckel et al. 2007). These

results show that populations of giant ragweed and waterhemp could be dramatically reduced if weed populations are managed intensively and seed production is prevented for 2 to 4 years, respectively.

Roguing weed escapes prior to seed production can help prevent replenishment of the seedbank. Species vary in how long it takes to form viable seed. Research by Bell and Tranel (2010) found that waterhemp could form viable seed 7 to 12 days after pollination. Seeds may also still mature on pulled plants if the plant pollinated before pulling. Regardless, NOT running the combine through a weed patch will help limit the spreading of weed seeds throughout the field. Also, manage weeds along field edges to help prevent buildup of the weed seedbank.

Incorporate sound agronomic tactics

Ensuring the crop is as competitive as possible (e.g. adequate fertility, planting population, and disease and pest control) and canopies as early as possible can help enhance weed control. Narrow rows, expanding crop rotations, and cover crops have the potential to aid in weed control as well.

Cultivation is another effective tool, allowing you to remove weeds without setting back the canopy as some postemergence herbicides can, leading to faster canopy closure and a more competitive environment for weeds. Cultivation was evaluated in Minnesota in 2015 and 2016 to evaluate its control of herbicide-resistant waterhemp. A preemergence application of Boundary (1.95 pt/acre) was followed by either Liberty (29 fl oz/acre) or mechanical cultivation. In 2016, final waterhemp control was significantly better with the Boundary/Cultivation treatment (98%) compared to the Boundary/Liberty program at 89 percent (Table 2). The soybean canopy also closed sooner where cultivation occurred, so waterhemp that emerged under the canopy in July after cultivation did not survive. No differences in yield were observed among the treatments. Similar results for weed control, canopy closure, and soybean yield were found in 2015.

Table 2. Waterhemp control using cultivation and herbicides for weed control at Rochester, MN in 2016. Means followed by different letters indicate a significant difference at $P \leq 0.10$.

Weed Control Tactic	Rate (Units ac ⁻¹)	Application timing	Waterhemp control (%)
Boundary fb Liberty	1.95pts / 29 fl oz	PRE/POST	89 a
Boundary fb cultivation	1.95pts / cultivation	PRE/POST	98 b

Additional resources

University of Minnesota Extension, Resistance Management website:
<http://www.extension.umn.edu/agriculture/weeds/resistance/>

References

- Bell, M.S. and Tranel, P.J. 2010. Time requirement from pollination to seed maturity in waterhemp (*Amaranthus tuberculatus*). *Weed Sci.* 58:167-173.
- Hicks, D. and Naeve, S. 1999. The soybean growers field guide for evaluating crop damage and replant options. University of Minnesota Extension.
- Goplen, J.J., Sheaffer, C.C., Becker, R.L., Coulter, J.A., Breitenbach, F.R., Behnken, L.M., Johnson, G.A., and Gunsolus, J.L. (2017a). Seed bank depletion and emergence patterns of giant ragweed (*Ambrosia trifida*) in Minnesota cropping systems. *Weed Sci.* 65:52-60.

- Goplen, J.J., Sheaffer, C.C., Becker, R.L., Coulter, J.A., Breitenbach, F.R., Behnken, L.M., and Gunsolus, J.L. (2017b) Giant Ragweed (*Ambrosia trifida*) Emergence Pattern Influenced by Spring Tillage Timing in Minnesota. Weed Technology (in-review)
- Goplen, J.J., Sheaffer, C.C., Becker, R.L., Coulter, J.A., Breitenbach, F.R., Behnken, L.M., Johnson, G.A., and Gunsolus, J.L. (2016). Giant ragweed (*Ambrosia trifida*) seed production and retention in soybean and field margins. Weed Technology 30:246-253.
- Sprague, C. (2013) Common lambsquarters management in soybeans. Take Action, United Soybean Board
- Steckel, L.E., Sprague, C.L., Stoller, E.W., Wax, L.M., and Simmons, F.W. 2007. Tillage, cropping system, and soil depth effects on common waterhemp (*Amaranthus rudis*) seed-bank persistence. Weed Sci. 55:235-239.